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The Swiss Alpine Glacier's Response to the '2 °C air temperature target'

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While there is consensus among observed and projected climate change, the assessment of the effective impacts of increased global mean air temperature on a specific regional-scale system remains challenging. Here, we take up the widely discussed concept of limiting global mean temperature to a certain target value, like the so-called 2 °C target, to assess the related impacts on the Swiss Alpine glaciers. A model set-up is introduced that uses and combines homogenized long-term meteorological observations and downscaled and de-biased transient gridded Regional Climate Model (RCM) simulations (ENSEMBLES) to drive a distributed glacier mass balance model under a global 2 °C target scenario. In our study, the global 2 °C target corresponding for Switzerland is met at around 2045. In order to allow time to all glaciers to fully adjusted to the new climate conditions of +2 °C, the mass balance model simulation is continued under stabilized +2 °C until 2150.

The changes of area, volume and glacier-based runoff until 2045 are analyzed for a total of 101 glaciers, which represent about 50% of the glacierized area and 75% of the ice-volume in Switzerland. Relative to the year 2000, the glacierized area and volume are both decreased to about 45% and 25%, respectively, and glacier-based runoff is reduced by about 60%.

In addition to the resulting numbers, the value of the study must be seen in the gained insights into the model's performance that go beyond the specification of glacier mass loss. In the course of the simulations, we could show that RCM data over complex mountain topography remain a major impediment. Furthermore, we have performed a straightforward uncertainty assessment to evaluate the sensitivity of several uncertainties such as glacier downwasting, glacier-size dependence or albedo lowering.